Fayoum University

Name of Candidate: Dalia arafa yousri **Degree: M.Sc.**

Title of Thesis: APPLYING BIOLOGICALLY INSPIRED ALGORITHMS TO SOLAR PHOTOVOLTAIC SYSTEM

Supervisors: 1- Prof. Dr. **Mahmoud Magdy Bahgat Eteiba**

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Department: Electrical Engineering **Department: Electrical power and machines** **Approval:-----------**

ABSTRACT

The renewable energy is expected to open a new avenue to overcome the lack and the high prices of the fossil fuels availability. Solar energy is one of the suggested solutions to overcome these problems due to its wide availability and its cleanliness. However, due to high initial cost of such systems, optimal capturing of the available solar energy has to be ensured to increase the efficiency of The PV systems. One of the main aspects that is needed for this purpose is the proper system design. Consequently, a reliable and an accurate PV modeling should be provided to optimize the performance of the system design before the installation. The simulation procedure may be divided into two stages. The first one is to prepare the mathematical model of the PV system, while the following stage is the parameters extraction techniques.

In this thesis, one of the most recent bio-inspired algorithm which is called Flower-Pollination Algorithm (FPA) is proposed to extract the global parameters of the PV solar models such as single and double diode models at various levels of the environmental conditions. The introduced optimization algorithm is inspired from the nature, where FPA technique was inspired by the flower pollination process of flowering plants. The results of the FPA algorithm at the models' parameters estimation illustrate that the most accurate modeling for different types of PV solar modules under different environmental conditions is justified through the computation of the least value of the Root Mean Square Error (RMSE), the best fitting of the (I-V) curves and the fastest convergence speed with the shortest execution time. To validate the previous results of these algorithm, its results are compared to that of the recent techniques published in literature in this field.

Additionally, more detailed models such as modified double diode (MDDM) and three diode (TDM) models are investigated to account for the physical complexity

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of the multi-crystalline cell/ module such as the effect of the grain boundaries, the carrier recombination and the leakage current. In this part, another new optimization algorithm which is called a Moth-Flame optimizer technique is introduced to estimate the parameters of the detailed models. MFO technique was inspired by the navigation method of moths in nature which is called transverse orientation. Moreover, Flower Pollination Algorithm (FPA) and Hybrid Evolutionary technique (DEIM) are tested on the detailed same models. The results of such these algorithms on all the detailed models show that MFO technique achieves the best performance upon it's application on the three diode model which represents the physical behavior of the multi-crystalline solar cells/ modules accurately, the least RMSE , the best (I-V) curve fitting, the fastest convergence speed and the shortest computation time. Furthermore, a deeper evaluation analysis is performed to verify the previous conclusions.